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MEASUREMENT OF PERFORMANCE OF HOLLOW SHAFT VENTILATORS AND DRUM RELEASED WATER SPRAYS ON D.E.R.D. SHEARER AT PRINCE MINE

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MICROMEDIA

MEASUREMENT OF PERFORMANCE OF HOLLOW SHAFT VENTILATORS AND DRUM RELEASED WATER SPRAYS ON D.E.R.D. SHEARER AT PRINCE MINE

by

W.G. Klinowski* and G.A. Haslett**

ABSTRACT

The efficient dilution of methane released during the cutting process and the adequate cooling of hot tracks formed by blunt cutting picks are essential measures that will reduce the risks of frictional ignitions caused by an operating shearer.

This report describes the equipment, test procedures and the results obtained from a shop floor investigation of the performance of the hollow shaft ventilators installed on a 270 kW Anderson Strathclyde double ended AMBROAS shearer. The assessment of the quantity and quality of water-flows from Green and Bingham drums equipped with "Jiffy" jets is also presented.

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MESURE DU RENDEMENT DES VENTILATEURS DE L'ARBRE CREUX ET DES PULVÉRISATEURS SOUS PRESSION INSTALLÉS SUR LA HAVEUSE D.E.R.D. UTILISÉE À LA MINE PRINCE

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RÉSUMÉ

La dilution efficace du méthane qui se dégage pendant le havage et le refroidissement adéquat des traces chaudes formés par les marteaux-piqueurs émoussés sont des mesures essentielles qui réduisent les risques d'inflammation par frottement causés par la haveuse en marche.

Dans ce rapport, l'auteur donne une description de l'équipement, des méthodes d'essai et des résultats obtenus lors d'une investigation en atelier de la performance des ventilateurs de l'arbre creux installés sur la haveuse de 250 kW AMBROAS à deux têtes de havage, de la Anderson Strathclyde. Une évaluation de la qualité et de la quantité du débit d'eau des tambours Green et Bingham munis de pics "Jiffy" est également présentée.

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INTRODUCTION

At the December 1985 meeting of the Frictional Ignition Working Group the Cape Breton Coal Research Laboratory was asked to measure the airflows induced through hollow shaft ventilators installed on a 270 kW Anderson Strathclyde double ended ranging drum shearer scheduled for the underground deployment at Prince mine.

This report describes the equipment, test procedures and results obtained from the data collected on January 10, 1986 in the surface shops of Prince mine.

The assessment of the performance of the drum installed water jets was also attempted. The tests which were essentially subjective indicated nevertheless some possible operational improvements that would reduce the probability of frictional ignitions.

HOLLOW SHAFT VENTILATOR

The hollow shaft ventilator is a device which induces an airflow from the free conveyor track through the bore of the hollow drum shaft on a shearer to the area around the drum face plate. Its purpose is to ventilate the zone around the multiple cutting picks upon the drum face and replace any methane that is released to non-flammable concentrations with air. The hollow bore of the drum shaft is equipped with a high pressure water spray. The water spray induces an axial airflow along the hollow shaft to discharge around the drum face plate.

It is recognized that three factors (1) have a major impact upon the efficiency of the hollow shaft ventilator:

1) Design

   The diameter of the hollow shaft, its geometry and specification of the water spray nozzle (location, area, spray pattern) will, in combination, dictate the maximum level of performance that can be attained.

2) Discharge Water Pressure

The water spray nozzle discharge entrains air and causes it to flow into the hollow shaft. The volume of air induced to flow through the system is directly related to the nozzle discharge pressure.

3) Mechanical Blockages and Damage

Accumulations of coal and dirt at the intake of the hollow shaft will reduce or stop the flow of air through the system. On shearers equipped with ranging outboard arms total blockage of the intake is not uncommon. Blocked or damaged water supply pipes and nozzles are also a common fault.

TEST EQUIPMENT

An orifice plate flow measuring device complete with an adapter to match an existing flat surface on the shearer drum moving is shown in Figure 1. Pressure drop across the orifice plate is measured with a gauge via tyglon tubing connected to pressure tap connectors on both sides of the orifice.

TEST PROCEDURES

A shop reconditioned 270 kW Anderson Strathclyde double ended AMBROAS shearer was assembled on the floor of the surface shops at Prince mine in preparation for its transfer underground.

In order to protect the internal cooling system from excessive pressure and, at the same time, to allow for the measurement of the performance of the hollow shaft venturis and spray nozzles at different water pressures, some changes had been made to the shearer's water distribution system.

A three-piston Fletcher Sutcliffe wild pump was provided to deliver water at controlled pressures to the shearer via a 32 mm diameter (1 1/4 in) flexible hose with a flow meter and a pressure gauge installed at the entrance to the shearer body. From there, through an altered piping system, water was supplied to both hollow shaft ventilators and to the sprays

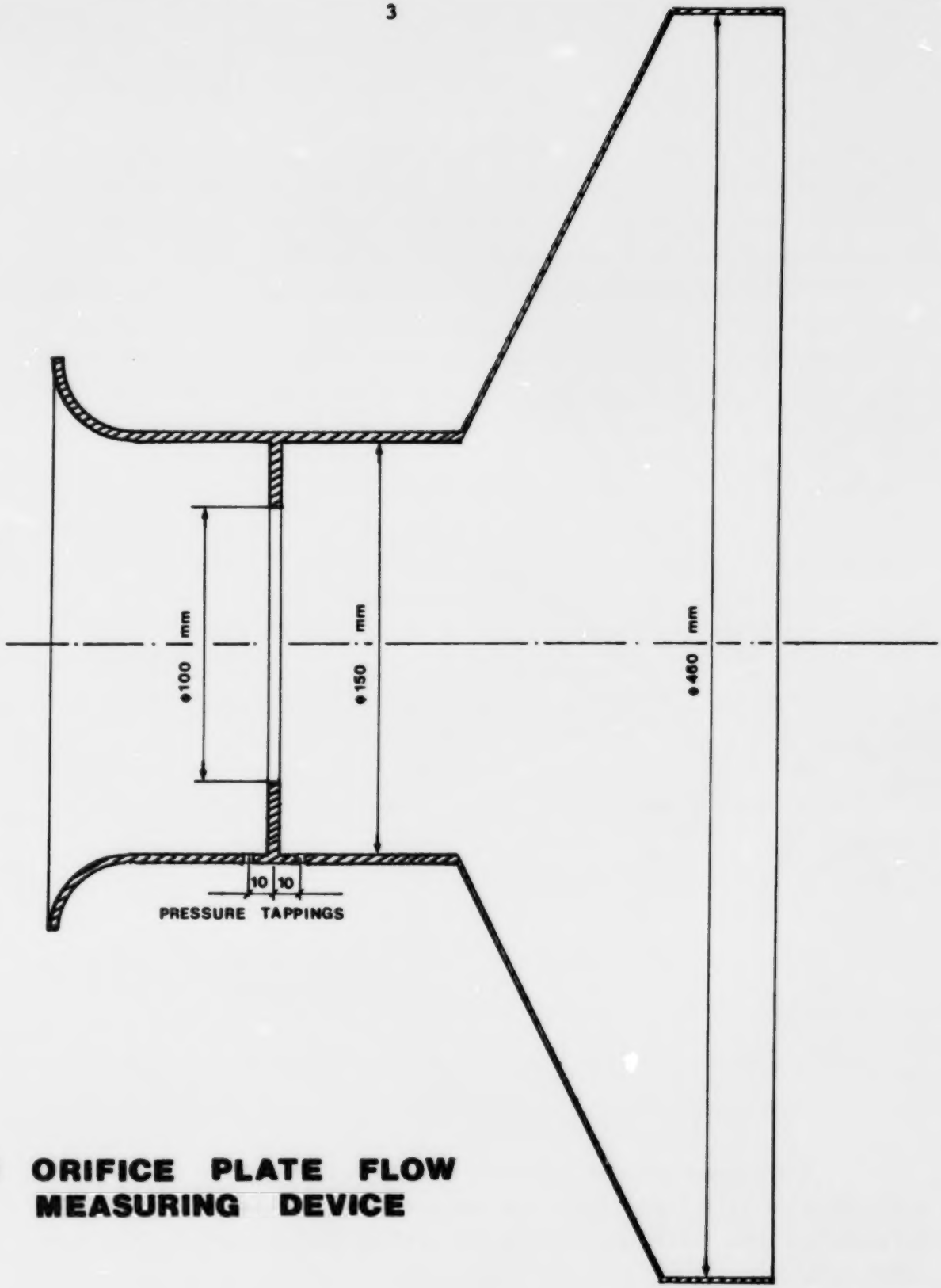

Fig1 ORIFICE PLATE FLOW MEASURING DEVICE

installed on both drums. Any of the tested components could be isolated to receive the full volume of water delivered by the external pump. Additional bar sprays, which are standard on the Anderson Strathclyde shearers, as well as the internal motor cooling conduits were disconnected.

Pressures and volumes of water flowing to the tested components during the trial were recorded, pressure drops across the orifice caused by the airflow in each hollow shaft were measured using the device described above and airflows were derived from calibration curves obtained for the orifice plate in wind tunnel tests.

TEST RESULTS

Table 1 - A record of the tests made on the left and right hand hollow shaft ventilators (H.S.V.)

Water Pressure delivered to the shearer		Total Volume delivered		Airflow Induced				Remarks
				L. Hand H.S.V.		R. Hand H.S.V.		
psi	bars	gpm	L/s	cfm	m^3/s	cfm	m^3/s	
475	32.8	32	2.42	87	0.041	163	0.077	Both drum sprays on
1050	72.4	23	1.74	138	0.065	180	0.085	All sprays off
1700	117.2	25	1.89	150	0.071	186	0.088	All sprays off
2500	172.4	27	2.19	180	0.085	233	0.11	All sprays off

The highest recorded volume of air passing through the hollow shaft was 0.11 m^3/s (233 cfm). This was induced by the total volume of water delivered to both H.S.V. at 2.19 L/s (27 gpm) at the pressure of 172.4 bars (2500 psi).

No quantified specific information has been recorded for gas released by the shearers operating at CBDC collieries. If, however, an

assumption is made that 5% of the total release from the face can be attributed to the shearer and this figure is applied to the average make on Fridays that occurred on 14N longwall face at No. 26 Colliery (2), then the release attributable to the shearer would be 0.0323 m^3/s (68.4 cfm).

From a comparison with figures quoted by Pitcraft from an investigation of the British National Coal Board's MRDE such a gas release would require 1.32 m^3/s (2811 cfm) of air to be circulated by an H.S.V. to provide effective dilution. The maximum circulated in these tests was 0.11 m^3/s (233 cfm) and the water pressure required to obtain this amount was 172.4 bars (2500 psi) which is far beyond a practical limit for the internal pipe system of a shearer.

PERFORMANCE OF DRUM INSTALLED JETS

The tested shearer was equipped with two similar drums manufactured by Green and Bingham. Each drum, having dimensions of 1.5 m (5 ft) diameter and 0.74 m (29 in) width, is equipped with 18 picks on the face plate and 6 picks on each of the three vanes to a total of 36 picks/drum. Provision is made in the construction of each drum for two sprays for each pick: one to apply a cone of water for pick face flushing and the other for back face flushing. These sprays have the commercial name of "Jiffy" jets, are made of brass and have a nozzle diameter of 0.8 mm (1/32 in).

The flow tests conducted on the drums were purely subjective but nevertheless provided some guidance. Water was supplied to the shearer at a pressure of 32.8 bar (475 psi) with both drums arranged to receive water. Observations of the sprays at these flow conditions suggest that for those in a vertical position the cones of spray reached estimated heights of approximately 1.2 m (4 ft) beyond the drum perimeter. Any given nozzle could be blocked from the pressure of an index finger applied to it.

Water was then supplied to the L.Hand drum only, at a pressure of 62 bar (900 psi) and a recorded flow of 2.57 L/s (34 gpm). The jet cones projected from those sprays in vertical position, reached estimated heights of approximately 2.13 m (7 ft) beyond the drum perimeter. No nozzle could be blocked by pressure of an index finger on it.

CONCLUSIONS

1) Hollow Shaft Ventilator

Presented results of trials indicate unsatisfactory low values of the airflows obtained in hollow shaft despite the nearly ideal testing conditions.

The H.S.V. induced volumes of airflow will be reduced even further underground due to the harsh operating environment, as has been indicated by the previous underground measurements of H.S.V. performance (3).

2) Drum Installed Jets

The flow pressure at the jet nozzles for a pressure applied to the shearer of 62 bar (900 psi) is estimated to be 30 bar (435 psi). Such a pressure is regarded as adequate to maintain the nozzles free from blockage - an imperative requirement for assured antifrictional ignition hazard.

Operation with the means and facilities to attain and maintain such a flow and pressure, 312 L/min (69 gpm), 62 bar (900 psi), to the shearer drums would be a desirable objective.

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